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## NEW LATE TERTIARY FISH FOSSILS FROM THE SINDA REGION, EASTERN ZAIRE

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**ABSTRACT** An assemblage of about 200 fish remains, recently collected from late Miocene - early Pliocene deposits of the Sinda area, is described. Although the collection is small, several taxa not previously reported from these localities are included. *Gymnarchus*, *Hydrocynus* and *Bagrus* are new for the Sinda-Mohari ichthyofauna, whereas the previously doubtful presence of Clariidae is now confirmed by several finds, including one identifiable as *Clarias*. The discovery of three outer premaxillary teeth of "Shungura *Sindacharax*" along with the numerous *Sindacharax lepersonnei* specimens is surprising. The Shungura form is considered conspecific with *Sindacharax lepersonnei*.

Other represented taxa are *Synodontis*, *Auchenoglanis* and *Lates rhachirhynchus*. Comparison of the ichthyofauna from the oldest deposits (Ongoliba Beds) with that of the Middle Member of the Sinda Beds shows a decline in characiforms and an increase in siluriforms through time. Reconstruction of the former aquatic environment indicates a large and deep permanent water-body with shallow and marshy habitats at its margins.

**RESUME** Environ 200 restes de poissons, récoltés récemment dans la région du Sinda et datant du Miocène supérieur-Pliocène inférieur, sont décrits. La collection est petite, mais a livré plusieurs taxons qui n'étaient pas encore connus de ces localités. *Gymnarchus*, *Hydrocynus* et *Bagrus* sont neufs pour l'ichthyofaune de Sinda-Mohari, tandis que la présence douteuse de Clariidae dans les anciennes collections est maintenant confirmée par plusieurs trouvailles, dont une identifiable comme *Clarias* sp. La découverte simultanée de trois dents prémaxillaires extérieures de "Shungura *Sindacharax*" et de nombreux spécimens de *Sindacharax lepersonnei* est surprenante. La forme de Shungura est considérée comme conspécifique avec *Sindacharax lepersonnei*.

Les autres taxons représentés sont *Synodontis*, *Auchenoglanis* et *Lates rhachirhynchus*. La comparaison de l'ichthyofaune des dépôts les plus anciens (Ongoliba Beds) avec celle du Middle Member des Sinda Beds montre, dans le temps, un déclin des characiformes et une progression des siluriformes. La reconstitution de l'environnement aquatique de l'époque indique des eaux permanentes, larges et profondes avec des habitats peu profonds et marécageux sur les bords.

**Key Words:** Palaeontology; Tertiary; Fish; Zaire.

## INTRODUCTION

The fish remains described here were collected in 1989 and 1990 during fieldwork carried out in the Sinda region by a joint Japanese-Zairean team under the direction of Prof. Ishida. Some fish remains were found at the right bank of the Sinda river, close to the junction with the Kahuga river (sites 1, 14 and 15). All the other

localities with fossil fishes are situated along the Kahuga river. Palaeontological work was combined with a geological survey of the study area (Makinouchi et al., this volume), which indicated that the recovered fossils are from the Sinda Beds. The sites with fish remains belong to three stratigraphic entities: the Ongoliba Horizon (sites 4, 5, 9, 10, 11, 12), the Middle Member (sites 1, 7, 17) and the Upper Member (sites 14 and 15). Sampling was effected by hand-collecting at the surface. According to the analysis of the mammalian fauna (Yasui et al., this volume), the Sinda Beds are late Miocene to early Pliocene in age.

The survey was carried out in the same region where fossils were collected previously by Belgian teams (Gautier & Lepersonne, 1963). Repeated reference will be made to these earlier finds of which the fishes were described in great detail (Greenwood & Howes, 1975). Moreover, the new finds will be compared to the recently described Pliocene ichthyofauna from the Lake Edward Rift (Stewart, 1990).

## MATERIAL

Identification could, in most cases, be carried out by comparison with the collections stored at the Royal Museum of Central Africa. These comprise dry, disarticulated skeletons of the most common recent African freshwater fishes as well as the paleontological material collected earlier in the Sinda-Mohari region (Greenwood & Howes, 1975). In Table 1 an overview is given of the finds described below.

<b>Class</b>	Pisces
<b>Order</b>	Mormyriiformes
<b>Family</b>	Gymnarchidae
<b>Genus</b>	<i>Gymnarchus</i> Cuvier, 1829

*Gymnarchus* sp.

### Materials:

teeth: SN-138 (Plate 1-1), 164, 168, 171, 172, 199, 200, 215, 218, 219, 308, 515, 521, 586

vertebra: SN-404 (Plate 1-2a,b)

The collection comprises 14 teeth of which 3 are squarish in outline, the others being triangular. Both types bear fine serrations at their edges. Comparison of the measurements of the isolated teeth from Sinda with a recent specimen of 94 cm standard length (SL), indicates that the fossil fishes were two to three times as long.

Thus far *Gymnarchus* has only been documented in palaeontological sites by isolated teeth (Schwartz, 1983; Stewart, 1990). The Sinda assemblage also includes a vertebral centrum from the caudal region. In *Gymnarchus* the haemal and neural arches typically do not fuse with the centrum. This explains why the fossil centrum from Sinda shows only the empty sockets in which the bases of the arcualia rest during life.

**Table 1.** Overview of the fish taxa identified from the different sites in the Sinda region.

taxon \ site	1	1A	1B	4	5	7	9	10	11	12	14	15	17	total
<i>Gymnarchus</i> sp.	1	-	-	1	7	1	-	-	-	1	-	4	-	15
<i>Sindacharax lepersonnei</i>	-	1	-	11	32	4	-	1	-	5	2	-	2	58
"Shungura <i>Sindacharax</i> "	-	-	-	-	1	-	-	-	-	2	-	-	-	3
<i>Sindacharax</i> sp.	-	-	-	-	1	-	-	-	-	-	-	-	-	1
<i>Hydrocynus</i> sp.	-	-	-	-	-	-	-	-	-	1	-	-	-	1
<i>Synodontis</i> sp.	-	-	-	1	-	6	-	1	-	1	-	-	-	9
<i>Auchenoglanis</i> sp.	-	-	-	-	-	4	-	-	-	-	-	-	-	4
<i>Bagrus</i> sp.	-	-	1	-	-	-	-	-	-	-	-	-	-	1
Bagridae indet.	-	-	-	1	-	-	-	-	-	-	-	1	-	2
<i>Clarias</i> sp.	-	-	-	-	-	1	-	-	-	-	-	-	-	1
Clariidae indet.	-	-	-	-	-	4	-	-	-	-	-	-	-	4
Siluriformes indet.	-	1	-	2	-	7	-	1	-	-	1	-	-	12
<i>Lates rhachirhynchus</i>	1	-	-	16	15	18	7	5	1	16	1	1	-	81
Perciformes indet.	-	-	-	-	-	1	-	1	-	1	-	-	-	3
Osteichthyes indet.	-	-	2	-	1	1	-	-	-	-	-	-	-	4
Total	2	2	3	32	57	47	7	9	1	27	4	6	2	199

The transversal diameter of the specimen measures 8.3 mm and corresponds to an individual of approximately 1.5 m SL.

These finds are the first proving the presence of *Gymnarchus* in the Lake Albert Rift.

**Order** Cypriniformes  
**Family** Characidae  
**Genus** *Sindacharax* Greenwood & Howes, 1975

*Sindacharax lepersonnei* Greenwood & Howes, 1975

#### Materials:

outer premaxillary teeth (= ? posterior outer dentary teeth): SN-140, 149, 167, 169, 170, 180, 184, 185, 187 (Plate 3-12a,b), 191, 193, 196, 208, 217, 545, 569, 584  
 first inner premaxillary teeth: SN-166, 176, 188, 190 (Plate 4-15), 214, 332, 585  
 second inner premaxillary teeth (= third outer premaxillary teeth): SN-150, 173, 175, 178, 179, 186, 212 (Plate 4-14), 306, 559, 582  
 third inner premaxillary teeth: SN-104, 137 (Plate 4-13), 165, 174, 182  
 outer dentary teeth, type I: SN-192, 210, 544, 583 (Plate 4-16a,b)  
 outer dentary teeth, cf. type I: SN-132, 194, 561  
 inner dentary teeth: SN-102, 103, 181, 189, 197, 213 (Plate 4-17), 253, 271, 311, 562, 568, 590

“Shungura *Sindacharax*” (= *Sindacharax lepersonnei*)

Materials:

outer premaxillary teeth: SN-183 (Plate 4-18), 298 (Plate 4-18), 307

*Sindacharax* sp.

Material:

tooth fragment: SN-169

The original description by Greenwood & Howes (1975) of *Sindacharax lepersonnei* was based on isolated teeth from the Sinda-Mohari area. After comparison of the dental morphology with that of living characoids, the authors tentatively placed the material in the Characidae family. This identification was later confirmed by discovery from the Shungura Formation of premaxillary bones with associated teeth (Greenwood, 1976).

In the species description Greenwood & Howes (1975) tried to establish the original position of the teeth. They distinguished inner and outer row teeth of the upper and lower jaw. This exercise was based on comparison of the fossil tooth morphology with that of extant species of *Colossoma* (a neotropical serrasalmine) and *Alestes*. However, the additional finds of *Sindacharax* from the Shunguru Formation demonstrated that the presumed positions of the isolated teeth, as defined in the original description, were partly wrong.

The new material of *Sindacharax* comprises 62 isolated teeth which were compared with the original collection and type material of *S. lepersonnei* stored at the Royal Museum of Central Africa. As might be expected, since both samples are from the same area and horizons, the majority of the new specimens indeed belong to *S. lepersonnei*. In the list of the material given above, we have grouped the teeth according to the divisions proposed by Greenwood & Howes (1975). We indicate, in parentheses, the new positions given to certain teeth after study of the Shungura material (Greenwood, 1976). Since the new Sinda material contained no jaw bones, we cannot further elucidate the original position of the teeth. However, the new assemblage is interesting in that it also yielded three teeth which correspond perfectly to the description of “Shungura *Sindacharax*”. These specimens occur on sites 5 and 12 where the typical *S. lepersonnei* is also present.

The new Sinda material shows that there is a close relationship between *S. lepersonnei* and the “Shungura *Sindacharax*”. Since teeth of both types were found at the same sites, it is likely that the two types are of one species. When describing the Shungura premaxillae with attached teeth, Greenwood (1976) noted that the previously described outer premaxillary teeth probably should be considered as outer dentary teeth. The present discovery at Sinda of nothing but outer premaxillary teeth of the “Shungura *Sindacharax*” type seems to indicate that those outer premaxillary teeth may in fact originate from *S. lepersonnei*.

Other finds seem to indicate that all *Sindacharax* recovered at this stage are to

some extent, related to each other. *Sindacharax deserti* (Greenwood, 1972) has been de-scribed from the Pliocene of Wadi Natrun. It differs in many respects from *S. lepersonnei* but there is a marked similarity in the presence of cusp ridges across the inner premaxillary teeth (Greenwood & Howes, 1975, p.105). Nevertheless, the two species can be very well separated according to their original descriptions. In Stewart's (1990) description of the Pliocene Upper Semliki fossil fishes, *Sindacharax ?deserti* and a morphological variant *Sindacharax* sp. are mentioned. Among the 164 *Sindacharax* teeth from the Upper Semliki, not a single specimen of *S. lepersonnei* was present. Due to the similarities between the Upper Semliki *S. ?deserti*, the Wadi Natrun *S. deserti* and also with the "Shungura *Sindacharax*" it was tentatively suggested that these three groups may be the same species. On the basis of the new Sinda discoveries we disagree with the placement of the "Shungura *Sindacharax*" in *S. deserti*. It remains obvious, however, that there is a large morphological variation in both *S. lepersonnei* and *S. deserti* which can result in an overlap of characters for certain teeth. This probably is a result of phenotypic plasticity, a phenomenon experimentally studied in various extant cichlids. It has been noted, for molluscivorous species, that the shape of the pharyngeal jaw apparatus as well as the number and size of the teeth vary with the amount of molluscs provided in the diet (Hoogerhoud, 1986; Witte et al., 1990).

**Family** Characidae  
**Genus** *Hydrocynus* Cuvier, 1817

*Hydrocynus* sp.

Material:  
 tooth: SN-303 (Plate 1-3)

A single of tooth from a tiger-fish was found at locality 12. Length reconstruction of the corresponding individual is difficult based on this element since tooth size differs according to its position on the jaw. We have the impression, however, that we are dealing with a medium-sized fish of maximum 50 cm SL.

This is the oldest record of the genus for the Lake Albert Rift basin. *Hydrocynus* has been reported previously from the Lake Edward area in the Lusso Beds of the Upper Semliki (Stewart, 1990).

**Order** Siluriformes  
**Family** Mochokidae  
**Genus** *Synodontis* Cuvier, 1817

*Synodontis* sp.

Materials:  
 pectoral spine: SN-070, 339, 344, 354, 387, 391, 409, 410 (Plate 1-4), 412

Identification of these elements was possible on the basis of the general shape of the spine and on the morphology of the articulation with the cleithrum (see Gayet & Van Neer, 1990). All specimens fall within the size range of 15-25 cm SL, the majority of the spines corresponding to individuals of approximately 20 cm SL.

*Synodontis* has been reported before from several fossil localities in the Western Rift (Stewart, 1990; Greenwood & Howes, 1975) but is also well known from northern and eastern sites dating from Miocene to present (Schwartz, 1983).

**Family**        Bagridae  
**Genus**        *Auchenoglanis* Günther, 1865

*Auchenoglanis* sp.

Materials:

frontal: SN-413 (Plate 2-8)

pectoral spine: SN-101, 346, 356 (Plate 1-5)

The morphology of the articulatory proximal end and the general shape of the spines allowed identification of this genus (Gayet & Van Neer, 1990). Moreover, a siluriform frontal could be attributed to *Auchenoglanis* after comparison with the reference collection.

This genus has been reported previously from the Sinda-Mohari region by Greenwood & Howes (1975). It was found in the Kabuga Formation and in the Mohari Beds, both described as Lower Miocene, as well as in the Ongoliba Bone Bed. The Lusso Beds have not yielded any *Auchenoglanis* thus far (Stewart, 1990).

**Family**        Bagridae  
**Genus**        *Bagrus* Bosc, 1816

*Bagrus* sp.

Material:

precaudal vertebra: SN-157 (Plate 2-9a,b)

The dorsal position of the transverse processes in this catfish vertebra is found only in *Clarotes*, *Chrysichthys* and *Bagrus*. Association of the collected vertebra with either one of the first two is excluded on the basis of the large antero-posterior diameter of the centra of these genera. The first free centrum of *Bagrus* is considerably more compressed. This vertebra belonged to an individual of about 70-80 cm SL.

*Bagrus* has not been reported previously from any Miocene or Pliocene locality of the Lake Albert-Lake Edward rift.

## Unidentified Bagridae

## Materials:

first vertebra: SN-043, 094

Two vertebral centra of Bagridae could not be identified with certainty beyond family level. They each represent the first vertebra, lying between the basioccipital and the Weberian apparatus. One specimen (SN-043) more or less resembles *Auchenoglanis*, whereas it is difficult to attribute the other specimen to one particular genus. Both vertebrae are from large individuals measuring approximately one metre SL.

**Family** Clariidae

**Genus** *Clarias* Scopoli, 1777

*Clarias* sp.

## Material:

pectoral spine: SN-408 (Plate 1-6)

A pectoral spine of a clariid can be attributed to the genus *Clarias* on the basis of the articular head. The serrated aspect is typical of *Clarias* and distinguishes it from *Heterobranchus* (see Gayet & Van Neer, 1990). Comparison of this spine with skeletons of recent fish with known dimensions demonstrates that we are dealing with an individual of 40-50 cm SL.

*Clarias* has occurred in eastern Africa since the Lower Miocene (Schwartz, 1983) but was thus far not known from the Western Rift. This catfish was not found in the Pliocene deposits of the Upper Semliki (Stewart, 1990), nor had its presence been attested with certainty in the Sinda-Mohari area (Greenwood & Howes, 1975).

## Unidentified Clariidae

## Materials:

frontal: SN-338, 416 (Plate 2-7a,b)

supraoccipital: SN-415

precaudal vertebra: SN-406

An identification beyond family level of these elements could not be made, partly because of the lack of diagnostic features, but also due to the fragmentary nature of the specimens.



## Unidentified Siluriformes

## Materials:

palatine: SN-353  
 pectoral spine: SN-144, 216, 269, 347, 355, 392, 411  
 dorsal spine: SN-211  
 cleithrum: SN-336  
 precaudal vertebra: SN-398  
 caudal vertebra: SN-350

Twelve catfish remains could not be identified precisely, mainly as a result of their fragmentary nature.

**Order** Perciformes  
**Family** Centropomidae  
**Genus** *Lates* Cuvier, 1828

*Lates rhachirhynchus* Greenwood & Howes, 1975

## Materials:

vomer: SN-386 (Plate 3-11)  
 parasphenoid: SN-598, 603  
 small neurocranium fragments: SN-127, 363  
 articular: SN-365, 555  
 dentary: SN-019, 341, 378, 616, 624, 633  
 maxilla: SN-128, 376, 554, 630, 659, 660  
 epihyal: SN-414, 619  
 preopercular: SN-364  
 gillraker: SN-394, 574  
 first vertebra: SN-031, 048 (Plate 3-10a,b), 096, 113, 342, 345, 361, 362, 372, 402, 578, 635  
 third vertebra: SN-034, 044  
 4th/5th vertebra: SN-020, 023, 025, 373, 390  
 other precaudal vertebrae: SN-022, 042, 369, 370, 381, 388, 399, 400, 407, 612, 613  
 caudal vertebrae: SN-021, 024, 029, 033, 038, 039, 040, 066, 343, 348, 351, 359, 371, 377, 379, 380, 382, 383, 384, 385, 389, 396, 397, 401, 403, 636  
 precaudal or caudal vertebra: SN-366

All the analysed *Lates* bones which bear diagnostic features, enabling a species identification, belong to the extinct *Lates rhachirhynchus*. They clearly differ from the numerous, recent, *Lates niloticus* specimens used for a previous study on the osteological variation of this species (Van Neer, 1987). Except for sites 11, 14 and 15 which each yielded only one undiagnostic *Lates* bone, the presence of *Lates rhachirhynchus* is attested at each locality with fish remains.

Only one incomplete vomer is present, but the preserved features closely match *L. rhachirhinchus*. The anterior portion is broken off, but a vomerine spine seems to have been present. Moreover, the ventral view clearly demonstrates that we are dealing with *L. rhachirhinchus*. As described by Greenwood & Howes (1975, p.83), the vomerine toothpatch differs from living species in that it is delimited from the edge of the vomer itself by a distinct shelf.

Excepting one specimen (SN-128) which is too badly preserved for detailed analysis, the other five maxillar heads belong to *L. rhachirhinchus* as described by Greenwood & Howes (1975, p.85-86).

Greenwood & Howes (1975, p.88) state that the dentary of *L. rhachirhinchus* differs only slightly from that of extant species. In the Sinda specimens we found that the dentigerous surface was mostly narrower than in *Lates niloticus*, but due to the bad preservation we were unable to verify the diagnostic value of the length of the openings to the lateral-line sensory canal. Those openings should be longer in *L. rhachirhinchus*. However, considering the variation observed in recent *Lates niloticus*, we are inclined to consider this criterion as less reliable (Van Neer, 1987).

All first vertebrae discovered at the Sinda localities match perfectly the specimens described by Greenwood & Howes (1975, p.91-93). Most of the centra are much shorter ventrally than dorsally and taper gradually from top to bottom when viewed laterally. Furthermore, the exoccipital facet area is small in comparison to the extant *Lates* species.

The two recovered third precaudal vertebrae are incompletely preserved and therefore difficult to compare with the original description of *Lates rhachirhinchus*. It is striking, however, that their centra are much narrower than in extant *Lates niloticus*. We are therefore inclined to attribute them also to *L. rhachirhinchus*.

In their original description of *L. rhachirhinchus* Greenwood & Howes (1975, p.94) were not able to make a precise distinction between the morphologies of the fourth and fifth vertebrae. Five of the new Sinda specimens seem to belong to this group.

The collection further contains posterior precaudal vertebrae and caudal vertebrae corresponding to the description of *L. rhachirhinchus*. The specimens clearly differ from the available *L. niloticus* reference skeletons.

Thus far, *Lates rhachirhinchus* has only been reported from the Sinda-Mohari area. The discoveries of *Lates* from the Lusso Beds in the Upper Semliki region have been only tentatively assigned to this species due to the fragmentary nature of the remains (Stewart, 1990).

## Unidentified Perciformes

### Materials:

fin spine fragments: SN-125, 393, 417

Three fragments of fin spine cannot be attributed with certainty to either Centropomidae or Cichlidae. Although the latter taxon has not been identified from this assemblage, the possibility that it was present cannot be ruled out *a priori*.

### Unidentified Osteichthyes

Materials: SN-367, 368, 374, 375

Of these remains it was only possible to state that they are derived from bony fishes. It was not even possible to identify their skeletal provenance.

### DISCUSSION AND CONCLUSIONS

In Table 2 an overview is given of the fish taxa identified in the new Sinda material, in the collection studied by Greenwood & Howes (1975) from the same area, and in the Lusso Beds from the Lake Edward Rift (Stewart, 1990). We also indicate which of these taxa are present in Lake Albert and Lake Edward today (Greenwood, 1966).

With its 200 specimens, the recently discovered fish fauna from Sinda is small. Nevertheless, it contributes significantly to the knowledge of the ichthyofauna from the Lake Albert Rift. Three genera which were previously unknown from the Miocene-Pliocene deposits of the Lake Albert region have been recorded: *Gymnarchus*, *Hydrocynus* and *Bagrus*. Moreover, the presence of the clariid family is attested with certainty and one specimen could be identified as *Clarias* sp. In the earlier described fauna from Sinda-Mohari, a few badly preserved specimens were only tentatively attributed to the Clariidae (Greenwood & Howes, 1975). Other taxa, such as *Protopterus* and *Clarotes*, were not present among the new Sinda collection. This may be due to the small sample size.

As was pointed out by Greenwood & Howes (1975) the Sinda-Mohari fauna is of a Nile-Zaire facies but with none of the endemic genera of these rivers being represented. Of the taxa found thus far in the Miocene-Pliocene deposits of Lake Albert, *Gymnarchus* and *Clarotes* are no longer living in the lake today and similarly are the extinct taxa *Sindacharax* and *Lates rhachirhinchus*. At least two of these taxa, *Clarotes* and *Lates rhachirhinchus*, survived in the area until early Pleistocene times (Greenwood & Howes, 1975). However, sites documenting the local extinction of those fishes are not yet available.

Recent field work has proved the existence of a rich ichthyofauna in the Pliocene Lusso Beds of the Lake Edward Rift (Stewart, 1990). The impressive list of taxa results from a combination of large sample size (5000 specimens) and the screening of sediment at several sites. It is still possible to compare the fossil ichthyofaunas from Lake Albert and Lake Edward and to retain some striking differences not resulting from the aforementioned parameters. Both faunas have a different species of *Sindacharax* and, moreover, *Lates rhachirhinchus* is only attested with certainty at Lake Albert. This seems to confirm that Lake Albert has been isolated for a long time, allowing the development of endemic species.

Considering the overall composition of the Sinda-Mohari and Lusso bed faunas, we see these as being comparable for the most part, both having a basic Nile-Zaire facies. Moreover, a similar evolution through time seems to have taken place in

**Table 2.** Fish taxa recorded from the Sinda Beds and from the Pliocene Lusso Beds, compared to the present-day ichthyofauna from Lake Albert and Lake Edward.

	Sinda-Mohari (Greenwood & Howes, 1975)	Sinda Beds (this report)	Lake Albert (Greenwood, 1966)	Lusso Beds (Stewart, 1990)	Lake Edward (Greenwood, 1966)
<i>Protopterus</i> sp.	×	-	×	×	×
<i>Hyperopisus</i> sp.	-	-	×	×	-
<i>Gymnarchus</i> sp.	-	×	-	×	-
<i>Labeo</i> sp.	-	-	×	×	×
<i>Barbus</i> sp.	-	-	×	×	×
<i>Distichodus</i> sp.	-	-	×	×	-
<i>Sindacharax lepersonnei</i>	×	×	-	-	-
<i>Sindacharax ?deserti</i>	-	-	-	×	-
<i>Hydrocynus</i> sp.	-	×	×	×	-
<i>Alestes</i> sp.	-	-	×	×	-
<i>Synodontis</i> sp.	×	×	×	×	-
<i>Auchenoglanis</i> sp.	×	×	×	-	-
<i>Bagrus</i> sp.	-	×	×	-	×
<i>Clarotes</i> sp.	×	-	-	×	-
Clariidae	?	×	×	-	×
<i>Lates rhachirhynchus</i>	×	×	-	?	-
<i>Lates niloticus</i>	-	-	×	×	-
Cichlidae	?	-	×	×	×

**Table 3.** Number of Sinda fish remains within the different stratigraphic units.

taxon	Ongoliba Horizon	Middle Member	Upper Member
<i>Gymnarchus</i> sp.	9	2	4
<i>Sindacharax lepersonnei</i>	49	7	2
"Shungura <i>Sindacharax</i> "	3	-	-
<i>Sindacharax</i> sp.	1	-	-
<i>Hydrocynus</i> sp.	1	-	-
<i>Synodontis</i> sp.	3	6	-
<i>Auchenoglanis</i> sp.	4	-	-
<i>Bagrus</i> sp.	-	1	-
Bagridae indet.	1	-	1
<i>Clarias</i> sp.	-	1	-
Clariidae indet.	-	4	-
Siluriformes indet.	3	8	1
<i>Lates rhachirhynchus</i>	60	19	2
Perciformes indet.	2	1	-
TOTAL	136	49	10

**Table 4.** Relative importance of the higher fish taxa in the Ongoliba Horizon and the Middle Member of the Sinda Beds.

	Ongoliba Horizon	Middle Member
mormyroid	6.6%	4.1%
characiform	39.7%	14.3%
siluriform	8.1%	40.8%
perciform	45.6%	40.8%

both faunas. In Table 3 the new Sinda material is grouped according to its presumed origin. These data should be used with caution since all the fish remains have been collected at the surface. Hence, the attribution to strata may be speculative in certain instances. *A priori*, it can be seen from this table that far-reaching interpretations should not be undertaken due to the unequal proportions of the sub-samples. When the Ongoliba Beds are compared to the Middle Member of the Sinda Beds we see a marked decline in the characiform character as well as an important increase in the siluriforms (Table 4). The limited decline in both mormyroids and percoids is probably not significant. Stewart (1990) noted a more or less similar evolution. She found a strong characiform and mormyroid character of the lower Lusso Beds. The mormyroid character is mainly due to the overwhelming number of isolated teeth of *?Hyperopisus*, elements which may have been overlooked in the Sinda-Mohari deposits. Cypriniforms, siluriforms and perciforms become more dominant in the upper Lusso Beds. At Sinda, cypriniforms are absent probably as a result of sampling techniques. Moreover, we note at Sinda that perciforms remain more or less equally represented in both Ongoliba Beds and the Middle Member. Although data from Lake Albert and Lake Edward Rift do not correspond perfectly, we note in both cases a marked decline in characiforms and an increase in siluriforms, giving the fauna a more modern composition.

On the basis of the ecological requirements of the represented taxa, it is possible to more or less reconstruct the former aquatic environment from which the fish are derived. The Sinda ichthyofauna comprises animals which are typical of shallow water habitats (Clariidae), fish of a more marshy environment with abundant aquatic vegetation (*Gymnarchus*), as well as taxa typical of open water (*Hydrocynus*, *Bagrus* and *Lates*). Of the latter category, *Hydrocynus* and *Lates* usually occur in well oxygenated, permanent waters. On the basis of the above it is impossible to establish whether the fish from Sinda are derived from a lake or a permanent river. However, it is clear that the represented taxa come from different facies of such a large waterbody.

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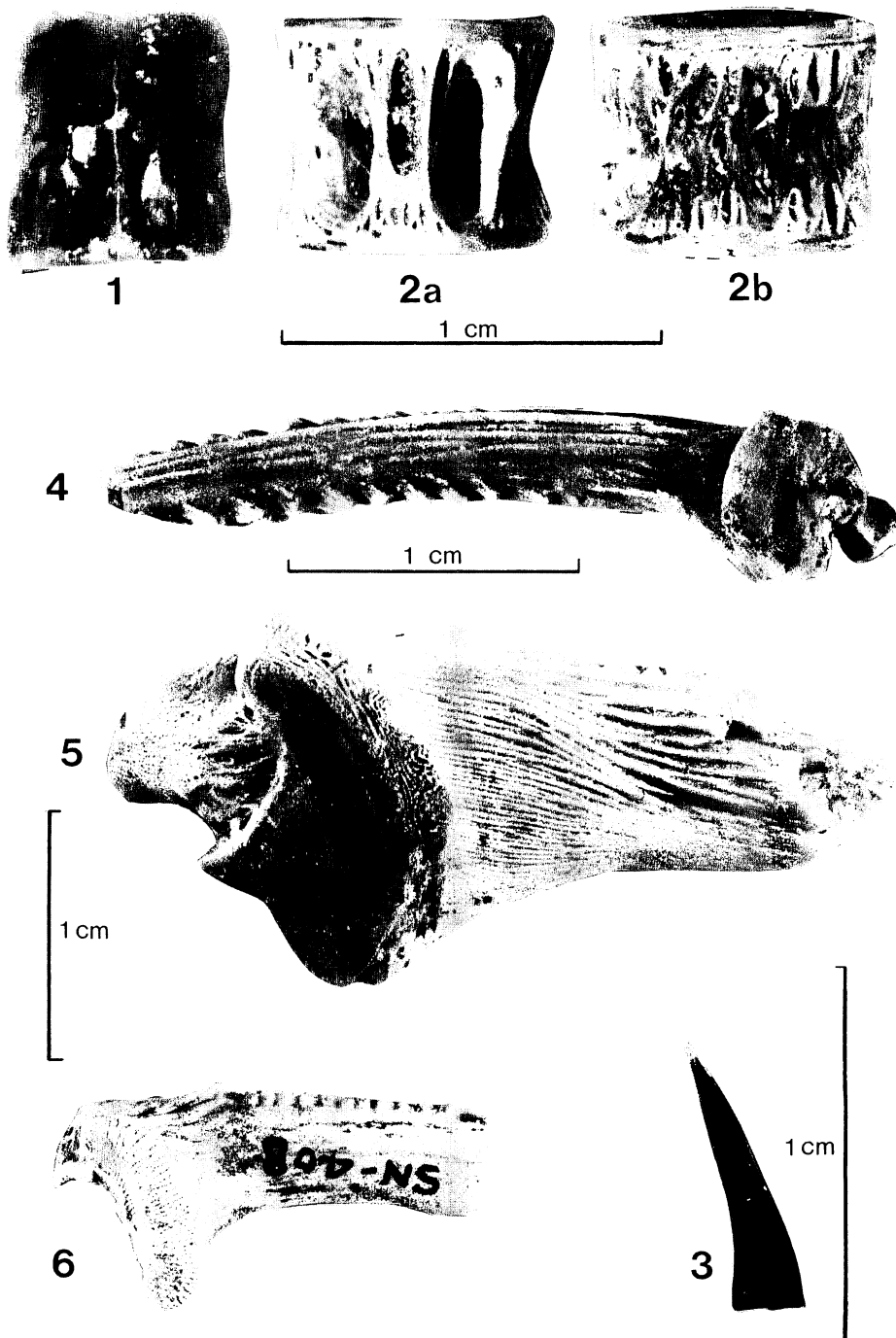
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## Explanation of Plate 1

- 1) Labial view of *Gymnarchus* tooth (SN-138)
- 2) Dorsal (a) and lateral (b) view of *Gymnarchus* caudal vertebra (SN-404)
- 3) Lateral view of *Hydrocynus* tooth (SN-303)
- 4) Dorsal view of left pectoral spine of *Synodontis* (SN-410)
- 5) Dorsal view of right pectoral spine of *Auchenoglanis* (SN-356)
- 6) Dorsal view of right pectoral spine of *Clarias* (SN-408)

Plate 1

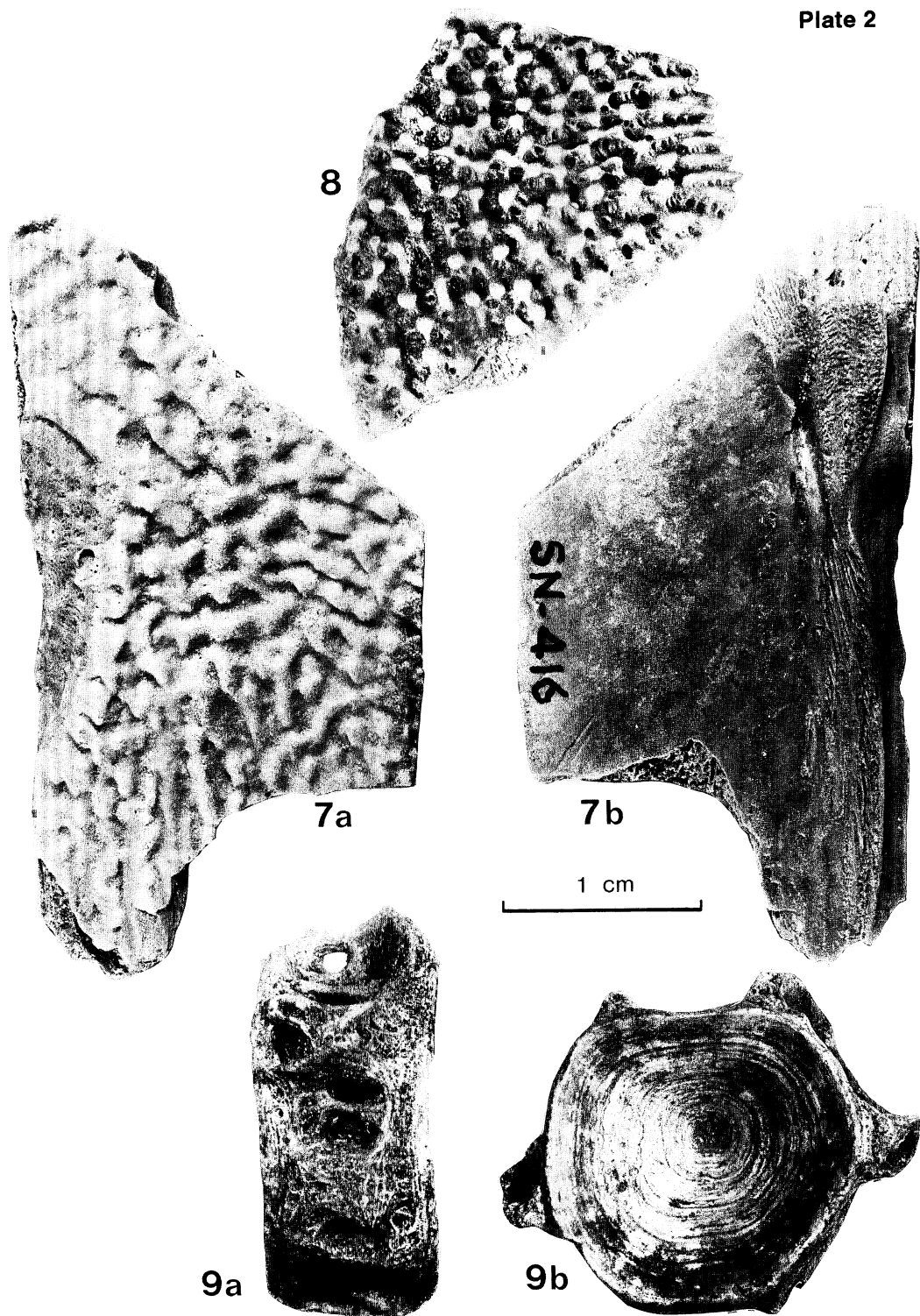




## Explanation of Plate 2

- 7) Dorsal (a) and ventral (b) view of frontal of Clariidae (SN-416)
- 8) Dorsal view of frontal of *Auchenoglanis* (SN-413)
- 9) Right lateral (a) and posterior (b) view of precaudal vertebra of *Bagrus* (SN-157)

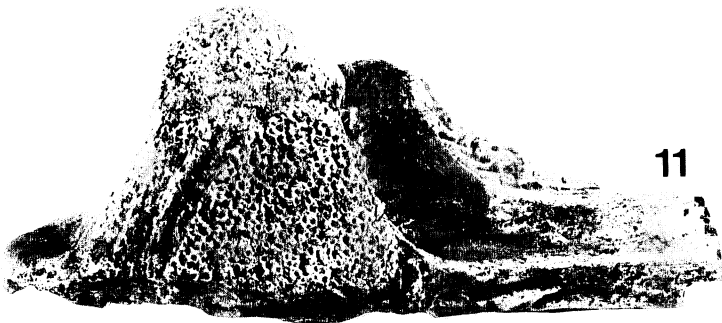
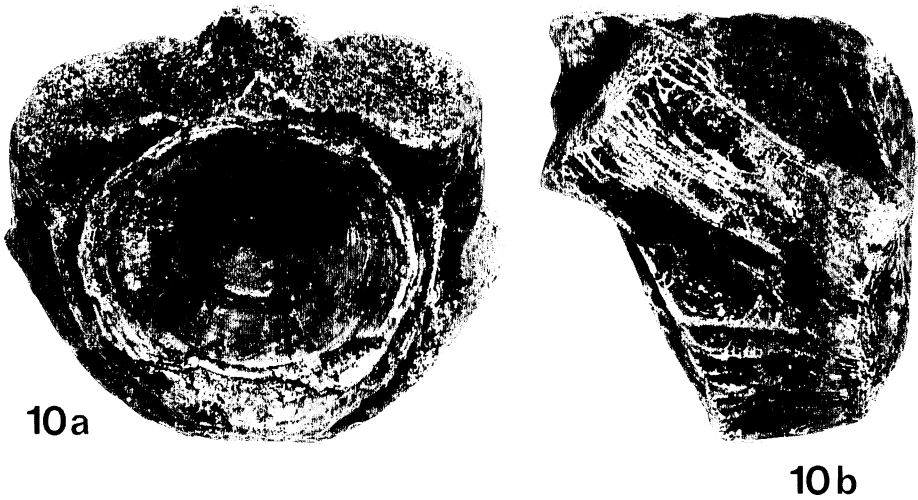
Plate 2



## Explanation of Plate 3

- 10) Anterior (a) and left lateral (b) view of first vertebra of *Lates rhachirhinchus* (SN-048)
- 11) Ventral view of vomer of *Lates rhachirhinchus* (SN-386)
- 12) Labial (a) and lateral (b) view of outer premaxillary tooth of *Sindacharax lepersonnei* (SN-187)

Plate 3



1 cm



## Explanation of Plate 4

- 13) Occlusal view of third inner premaxillary tooth of *Sindacharax lepersonnei* (SN-137)
- 14) Occlusal view of second inner premaxillary tooth of *Sindacharax lepersonnei* (SN-212)
- 15) Occlusal view of first inner premaxillary tooth of *Sindacharax lepersonnei* (SN-190)
- 16) Labial (a) and lateral (b) view of outer dentary tooth of *Sindacharax lepersonnei* (SN-583)
- 17) Labial (a) and lateral (b) view of inner dentary tooth of *Sindacharax lepersonnei* (SN-213)
- 18) Occlusal view of outer premaxillary teeth of "*Shungura Sindacharax*" (SN-183 and 298)

Plate 4

